VIA E-MAIL

September 15, 2008

Joe Eller
BAQ Permitting
Department of Health and Environmental Control
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RE: Santee Cooper Pee Dee Case-by-Case MACT
Followup for Beyond the Floor Analysis

Dear Mr. Eller:

This letter provides additional information that you have requested in regards to the Beyond the Floor (BTF) analysis submitted with the Santee Cooper Pee Dee Case-by-Case MACT Permit Application. One question addressed the mercury BTF analysis and requested details on alternative control device configurations. The remaining question addressed the proposed surrogate limits proposed by Santee Cooper for non-mercury hazardous air pollutants (HAP).

MERCURY BEYOND THE FLOOR – ALTERNATE CONTROL CONFIGURATIONS

The proposed Pee Dee units include the following emission control equipment.

- ▲ Selective catalytic reduction (SCR)
- ▲ Fabric filter (FF)[1]
- ▲ Wet flue gas desulfurization (WFGD)

With the proposed Pee Dee configuration (SCR/FF/WFGD), high removal rates of both mercury and SO_2 are achieved, and acid gases are maintained at a low level. In addition, with this control device configuration fly ash captured in the fabric filter can be sold for use in cement or concrete redi-mix and gypsum produced in the WFGD system can be sold for use in either cement or wallboard.

DHEC requested that Santee Cooper consider potential changes in mercury control resulting from the following control configurations as compared to the current SCR/FF/WFGD configuration. Based on our review, none of the different configurations considered here would result in lower mercury emissions than the proposed Pee Dee units.

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[1] The particulate matter control device was revised from an electrostatic precipitator (ESP) to a fabric filter as a result of the case-by-case MACT analysis to achieve greater mercury removal.

1. Spray dryer absorber (SDA) in lieu of WFGD (SCR/SDA/FF)
2. SDA and WFGD (SCR/SDA/FF/WFGD)
3. Addition of an electrostatic precipitator (ESP) upstream of FF (i.e., SCR/ESP/FF/WFGD)
4. ESP and ACI added upstream of FF (SCR/ESP/ACI/FF/WFGD)
5. Two ESP in series in lieu of FF (i.e., SCR/ESP/ESP/WFGD)

1. SDA in lieu of WFGD

With an SDA system, lime slurry is injected into the flue gas stream prior to the fabric filter, whereas in Pee Dee the WFGD is after the fabric filter. The slurry is dried to a powder as it absorbs SO_2 and SO_3 (the primary acid gas). This dried powder is collected with the fly ash in a fabric filter. Dry FGD systems can only achieve SO_2 removal efficiencies of approximately 90% whereas the Pee Dee WFGD can achieve 98% SO_2 removal. Because of the lower SO_2 collection efficiency capability, SDA systems are mostly only applied to low sulfur coal applications where the lower collection efficiencies are permitted; they are common on units firing lower sulfur sub-bituminous coals. Additionally, because the fly ash is contaminated, the dry product material captured in the fabric filter can not be sold for use in cement or concrete redi-mix and would need to be landfilled, resulting in an increase in the land area required for disposal and a loss of beneficial reuse.

The proposed Pee Dee system has the dual benefits of a FF to remove all fractions of mercury plus a downstream WFGD to remove any oxidized fraction that is not removed by the FF. In contrast, the SDA system is upstream of the FF.

For mercury specifically, it is unclear what result might occur from replacement of a WFGD with a SDA, as there are no comparable data available from similar sources. However, Santee Cooper does not expect any decrease in mercury would result from this switch.

2. SDA and WFGD

This system adds an SDA prior to the fabric filter and maintains the WFGD in place. This system is only offered by one manufacturer at present. In this system, the SDA uses a much smaller amount of lime slurry than the SDA discussed above, and primarily absorbs acid gases. This dried powder is collected with the fly ash in the fabric filter. From the fabric filter, the gas enters a conventional WFGD where SO_2 is captured. By collecting the acid gases in the SDA, the WFGD can be constructed of less costly, less corrosion resistant materials than the conventional WFGD which is offset by the increased cost from adding the SDA. This system adds to the flue gas pressure requiring higher fan power consumption and reduces the net output by more than 1 MW.

Mercury emission reduction with this system is expected to be comparable to the control device configuration proposed by Santee Cooper. For the one facility currently proposed with this SDA/WFGD combination (Duke Cliffside), the mercury emissions limit proposed in the permit application is 40% higher than proposed for Pee Dee.

3. ESP added upstream of FF

The addition of an ESP upstream of a FF is not likely to result in higher mercury emissions than the proposed configuration for Pee Dee. In the currently proposed configuration, all PM is captured by the FF and provides a heterogeneous filter cake that provides excellent control of all phases of mercury.

Adding an ESP upstream of the FF would result in a substantial change in the filter cake on the downstream FF. The ESP would remove most of the larger particles that would otherwise collect on the FF cake and assist in mercury removal. Between 80% and 95% of the PM mass would be captured in the ESP, resulting in a small fraction in the FF filter cake consisting of almost all fine particles. The change in effectiveness of such fine ash particles in adsorbing mercury, either due to particle morphology or uniform size, is unknown, but the nature of such particles (spherical condensed ash) suggests that adsorption properties would not be as good as a heterogeous mixture of particles. And, of course, the filter cake would have less ash mass per unit of mercury to adsorb the mercury if 95% of the ash were collected by the ESP. Hence, the ESP/FF combination would be likely to result in higher mercury emissions than the proposed Pee Dee unit.

4. ESP/ACI added upstream of FF

This configuration is like No. 3, but adds activated carbon injection (ACI) between the ESP and the FF. By capturing the bulk of the fly ash in the ESP prior to the injection of ACI, most of the fly ash would not be contaminated with ACI and would still be suitable for sale. A portion of the fly ash would continue to be contaminated with ACI and require landfilling.

Note that it is unclear whether this configuration could provide any emissions reduction beyond the base case. As discussed in No. 3, the removal of a substantial portion of PM via the ESP would result in a significant reduction in the size and composition of the filter cake, and result in a decrease in mercury removal across the FF. While the injection of ACI would ameliorate at least some of this loss of filter cake, it is unclear whether the ACI would even reach the mercury removal of the Pee Dee base case, let alone exceed the proposed Pee Dee performance.

Notwithstanding the significant questions regarding the comparative efficacy of this control configuration, Santee Cooper has updated the previously submitted BTF cost calculation for ACI injection. For the purposes of a cost calculation, it is assumed that 95% of the fly ash is captured in the ESP with 5% in the FF. For simplicity and given the clearly excessive resulting cost of mercury control, this calculation assumes no difference in the cost of an ESP/FF combination, even though clearly there would be substantial additional capital and operating costs associated with the addition of the ESP.

In the June 30, 2008 case-by-case MACT permit application, the calculated cost of ACI for mercury control was $188,349/lb, with 100% of the fly ash requiring landfilling. In the revised analysis in Attachment A to this letter, assuming only 5% of the fly ash requires landfilling, the cost for ACI control would drop to $143,207/lb. However, this lower cost is still far above values that EPA has previously determined to be cost effective, even without considering the additional costs of two separate PM control devices.

5. Replacing FF with two ESPs

Using two ESPs in series would result in a similar benefit as the prior example, which is that much of the fly ash could be sold even with ACI injection, which would occur downstream of the first ESP. However, as discussed in the case-by-case MACT application, a fabric filter can provide superior mercury control as compared to an ESP. Thus, this combination would provide no benefit over the ESP/FF combination discussed in the prior example and would be highly likely to provide less mercury control than the proposed system for Pee Dee.

NON-MERCURY BEYOND THE FLOOR – SURROGATE LIMITS

The proposed Pee Dee units include the following proposed emission limits for non-mercury HAP.

- Metal HAP – 0.012 PM_{10} filterable (3-hr stack test)
- Acid Gas HAP – 0.12 lb/MMBtu SO_2 (30-day CEMS)
- Organic HAP – 0.15 lb/MMBtu CO (30-day CEMS)

DHEC requested that Santee Cooper review the RBLC and other data for facilities with lower limits than those proposed by Santee Cooper. For similar sources with lower limits than proposed for Pee Dee, DHEC requested that Santee Cooper justify the rationale supporting higher limits for Pee Dee. Were any comparable sources determined to have lower limits than proposed for Pee Dee, DHEC requested post-control emissions and calculations for those facilities. Since the two controlled compounds (PM_{10} filterable and SO_2) proposed for Pee Dee have the lowest limits of a comparable source, this last request is moot.

As part of the Prevention of Significant Deterioration (PSD) permitting process, Santee Cooper presented an extensive list of facilities and their emission limits for PM_{10} filterable, SO_2, and CO. Based on the PSD permit application and subsequent additional information, DHEC made a preliminary determination that each of the above numeric limits represented Best Available Control Technology (BACT) for PM_{10}, SO_2, and CO respectively. Each of these proposed BACT limits reflects a very stringent emissions control level that is only achievable by state-of-the-art pollution control technology. Notably, DHEC made this case-by-case determination for each pollutant in accordance with the rigorous top-down BACT process, which requires DHEC to consider a similar set of factors as must be evaluated during the MACT standard-setting process. As a result, the proposed BACT control levels for PM_{10} filterable, SO_2, and CO establish excellent benchmarks for DHEC in setting MACT performance levels during the BTF stage of the standard-setting process.

PM_{10} Filterable

As discussed on Page 52 of the submitted case-by-case MACT application, the proposed PM_{10} filterable limit is the lowest of the comparable sources identified. Santee Cooper is not aware of any limits for a similar source lower than the level proposed for Pee Dee. Santee Cooper's

Response to Public Comments on the Draft PSD Permit for Pee Dee Generating Station provides additional discussion on the proposed PM_{10} limit.[3]

SO_2

As discussed on Page 53 of the submitted case-by-case MACT application, the proposed SO_2 limit is the lowest of the comparable sources identified. Santee Cooper is not aware of any limits for a similar source (i.e., combusting predominantly Eastern bituminous coal) lower than the level proposed for Pee Dee. Santee Cooper's *Response to Public Comments on the Draft PSD Permit for Pee Dee Generating Station* provides additional discussion on the proposed SO_2 limit.

CO

As discussed on Page 54 of the submitted case-by-case MACT application, the proposed CO level of 0.15 lb/MMBtu is not the lowest of the comparable sources identified, but rather represents a median value. The CO floor was determined to be 0.16 lb/MMBtu, and the proposed level for Pee Dee represents a BTF limit.

Table 9 from DHEC's preliminary determination (dated December 7, 2007) identifies the following units with lower CO limits than that proposed for Pee Dee.

- ▲ Thoroughbred (KY) 0.1 lb/MMBtu
- ▲ Trimble (KY) 0.1 lb/MMBtu
- ▲ Big Cajun (LA) 0.135 lb/MMBtu
- ▲ Elm Road (WI) 0.12 lb/MMBtu
- ▲ Longview Power (WV) 0.11 lb/MMBtu

Additionally, the following sources were identified with CO levels below that proposed for Pee Dee.

- ▲ Duke Cliffside (NC) 0.10 lb/MMBtu
- ▲ Consumers Energy (MI) 0.10 lb/MMBtu
- ▲ Dominion Clover (VA) 0.10 lb/MMBtu

Based on review of these sources, important distinctions between these sources and Pee Dee result in a lack of comparability between the CO emissions. Perhaps most importantly, given the inverse relationship between NO_X and CO emissions, it is important to consider the NO_X performance of any source with a CO emission limit value below that proposed by Pee Dee. Consideration of NO_X brings in an additional complexity, which is the relative ease with which sub-bituminous coals can control NO_X compared to bituminous units. Thus, a sub-bituminous unit is also not appropriate for comparison.

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[3] Submitted July 15, 2008.

The following two units with lower numerical CO limits are not comparable to Pee Dee due to their combustion of sub-bituminous coal.

- Big Cajun (LA)
- Consumers Energy (MI)

The following three combustion units with lower numerical CO limits are not comparable to Pee Dee due to their higher NO_X lb/MMBtu emission rate limits.

- Thoroughbred (KY) +0.01 lb/MMBtu
- Trimble (KY) +0.04 lb/MMBtu (NSPS limit equivalent)
- Dominion Clover (VA) +0.25 lb/MMBtu

The remaining three plants are discussed in additional detail: Elm Road (WI), Longview (WV) and Cliffside (NC).

Elm Road has an equivalent NO_X limit and a slightly lower CO lb/MMBtu limit compared to Pee Dee. However, the Elm Road CO and NO_X limits do not apply during startup and shutdown (SUSD), and further only apply during steady state operation, as defined below.

> *Startup period begins with the firing of fuel and ends when the temperature of the flue gas entering selective catalytic reduction (SCR) system exceeds 650 degrees F. The shut down period begins when the temperature of the flue gas entering SCR system temperature drops below 650 degrees F, and shall end with the cessation of fuel firing. Steady state operation is defined as any hour in which no mills are started or stopped or no stabilization fuel is used in the boiler.* [4]

In contrast, Pee Dee has emission limits for both NO_X and CO that apply during SUSD and during non-steady state operation. As such, a direct comparison between the Elm Road and Pee Dee emission limits for CO cannot be made.

Cliffside Unit 6 has recently received its PSD permit and has an application pending for a case-by-case MACT permit. In the issued Unit 6 PSD permit, the CO BACT emission limit was established at 0.12 lb/MMBtu, and Duke later proposed to lower this limit to 0.10 lb/MMBtu via the case-by-case MACT application. However, both the issued PSD permit and the MACT application use stack testing (Method 10) as the compliance method, and there is no CO CEMS. Since stack testing cannot be conducted during SUSD or during significant transient conditions, the result of the compliance method is that Cliffside, like Elm Road, excludes operating conditions that are likely to result in higher CO emissions. Compared to the CEMS monitoring included at Pee Dee, the Cliffside monitoring is effectively much less rigorous, and like Elm Road, a direct comparison with between Cliffside and Pee Dee cannot be made.

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[4] Permit NO. 03-RV-166, dated January 14, 2004. See either Page 9, Note 1 (NO_X) and Page 11, Note 1 (CO) – identical text is used for both CO and NO_X.

The last source to consider is Longview. Longview includes a comparable NO_X emission limit to Pee Dee, with a lower CO limit. The basis for the CO limit is not clear from available data. In contrast to the other permits considered here, the Longview permit issued by West Virginia is very brief at only 25 pages and is silent on important details, such as treatment of SUSD and transient operations. While Longview may be comparable to Pee Dee, adequate information regarding the boiler is not available to definitively arrive at that conclusion.

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If you have any additional questions, please contact Julie Jordan Metts, P.E. at (843) 761-8000, extension 4688.

Sincerely,

Jay Hudson, P.E.
Manager
Environmental Management

cc: Elizabeth Basil

JH:JJM

ATTACHMENT A

Revised Table E-2 from June 30, 2008 Application
Beyond the Floor Mercury Removal Cost
Combination ESP/FF Particulate Control System

Table E-2. Cost Analysis for Activated Carbon Injection (ACI) - Combination ESP/FF PM Control System

Capital Cost	Pee Dee 1	OAQPS Notation[1]
Purchased Equipment Costs		
Total Equipment Cost[2]	2,290,000	A
Total Purchased Equipment Costs	*2,290,000*	*B*
Direct Installation Costs		
Total Direct Installation Costs[3]	*620,000*	*C*
Indirect Installation Costs		
Total Indirect Installation Costs[4]	*2,290,000*	*D*
Total Capital Investment	**5,200,000**	**TCI = (B + C + D)**

Operating Cost	Pee Dee 1	OAQPS Notation
Direct Annual Costs		
Operating Labor (1/2 hr, per 8-hr shift)	13,407	E
Supervisory Labor	2,011	F = 0.15 × E
Maintenance Labor (1/2 hr, per 8-hr shift)	14,753	G
Maintenance Materials	14,753	H = G
PAC Use	7,371,540	I
Landfilling (5% of fly ash)	71,458	J
Lime Use (5% of fly ash)	31,220	K
Lost Revenue from Sale of Ash (5% of fly ash)	34,688	L
Total Direct Annual Costs	*7,553,831*	*DAC = E + F + G + H + I + J + K + L*
Indirect Annual Costs		
Overhead	26,955	L = 0.60 × (E + F + G + H)
Administrative Charges	104,000	M = 0.02 × TCI
Property Tax	52,000	N = 0.01 × TCI
Insurance	52,000	O = 0.01 × TCI
Capital Recovery[5]	490,843	P
Total Indirect Annual Costs	*725,798*	*IDAC = L + M + N + O + P*
Total Annual Cost	**8,279,630**	*TAC = DAC + IDAC*
Pollutant Removed (lb/yr)	58	
Cost per pound of Hg Removed	**143,207**	*\$/lb = TAC / Pollutant Removed*
Haz Waste Combustor MACT Cost Effectiveness Threshold[6]	4,536	*\$/lb Hg = TAC / Pollutant Removed*
Proposed Safety Valve Treshold in CAMR[7]	35,000	*\$/lb (converted from \$/ounce)*

1. U.S. EPA OAQPS, *EPA Air Pollution Control Cost Manual (6th Edition)* , January 2002, Section 5.2, Chapter 1. Values based on average requirements specified in OAQPS Manual, Section 5.2, Chapter 1, pages 1-27 and 1-28 unless otherwise noted.
2. Estimated cost of Material for Activated Carbon Injection System from Wheelabrator / Siemens budget quote. Assumes this quote includes the cost of instrumentation, sales tax, and freight.
3. Estimated cost of Balance of Plant (BOP) for Activated Carbon Injection System from Wheelabrator / Siemens budget quote. Assumes this quote includes the cost of foundations and supports, handling and erection, electrical, piping, insulation, and painting.
4. Estimated cost of Labor for Activated Carbon Injection System from Wheelabrator / Siemens budget quote (1.0 times material). Assumes this quote includes the cost of engineering, construction and field expenses, contractor fees, start-up, performance test, and contingencies.
5. Capital Recovery calculated based on Equations 1.33 and 1.34 of OAQPS Manual, Section 4.2, Chapter 1, pages 1-37 and 1-38.
6. 40 CFR 63 Subpart EEE, 64 FR 52863. Cost of $10,000,000 per mega-gram which converts to $4,536/lb. Note these are 1999 dollars and are not converted here.
7. See 70 FR 28630. A safety valve was proposed in CAMR though not adopted in the final rule.